Water Quality in Kansas

Kansas Water Hub

University of Kansas

June 24th, 2024

Motivation for Project

Improve the State's Water Quality

Where do we think about water quality?

Surface Water Quality

Nitrates, phosphorus, atrazine, bromides, uranium, chlorides and other contaminants are impacting surface water quality.

Public Water Supply Systems

Water quality testing in public supply systems is necessary for these systems to maintain compliance with the Safe Drinking Water Act.

Groundwater Quality

Though the ground serves as a great filtration system, chemicals and gases can still cause groundwater quality issues and contamination. Groundwater contaminants may be natural or human-caused.

Data, Research, and Study Needs

Continue investigation of historical HAB occurrences, the factors that cause HABs, and methods to prevent and treat HABs.	Support the Groundwater Management District (GMD) 5 study with Kansas State University (KSU) concerning nitrate levels in private wells with assistance from KDA-Division of Conservation and KDHE.
Support mineralization studies including those conducted by KDHE and KGS in southwest and northwest Kansas.	Facilitate/support data collection of groundwater and surface water quality.

Table: Kansas Water Plan Highlighted Needs

Questions of Interest

Where are water quality needs the greatest?

Which communities face the most significant water quality needs, and how can this be measured across the range of characteristics. Is there a composite measure that is useful?

How can we overlay water quality measurements with demographic information?

What is the geographic mapping that makes the most sense to connect demographic information with surface water quality tests?

How do we think about the relationship between surface water and public water systems?

We have information about water quality testing for both surface water and public water supplies. Is there a benefit to linking this data in some way?

Overview of Data

Organizations in Water Quality Portal Collecting Information about Kansas

Organization	Count	Percent	Cumulative Percent
Blue River Watershed Association	27	0.00	0.03
CSC (Computer Sciences Corporation)	115	0.00	0.04
Cheyenne and Arapaho Tribes of Oklahoma	66	0.00	0.04
EMAP-Great Rivers Ecosystems	17,787	0.62	0.66
EPA National Aquatic Resource Survey	416	0.01	0.67
EPA National Aquatic Resources Survey (NARS)	30,342	1.06	1.73
EPA R7	91,533	3.19	4.92
Kansas Biological Survey	135	0.00	4.93
Kansas Department Of Health And Environment	1,599,203	55.74	60.67
Kansas Water Office	1,231	0.04	60.71
Kaw Nation, Oklahoma (Tribal)	449	0.02	60.73
Kickapoo Tribe of Indians of the Kickapoo Nation	15,829	0.55	61.28
Missouri Dept. of Conservation	3	0.00	61.28
Missouri Dept. of Natural Resources	324	0.01	61.29
National Park Service Water Resources..	1,066	0.04	61.33
Nebraska Department of Environment an..	10,786	0.38	61.70
North American Lake Management Society	206	0.01	61.71
Oklahoma Dept. of Agriculture, Food a..	32	0.00	61.71
Peoria Tribe of Indians of Oklahoma	583	0.02	61.73
Prairie Band Potawatomi Nation (Tribal)	30,993	1.08	62.81
Quapaw Tribe of Indians, Oklahoma (Tr..	430	0.01	62.83
Sac & Fox Nation of Missouri in Kansas	4,372	0.15	62.98
US EPA Region 7	8	0.00	62.98
USEPA	4,004	0.14	63.12
USGS Kansas Water Science Center	1,058,014	36.88	100.00
USGS Missouri Water Science Center	38	0.00	100.00
USGS Oklahoma Water Science Center	14	0.00	100.00

Primary Organizations Used in Data

Kansas Department of Health and Environment

1. KDHE maintains surface water quality standards

US EPA Region 7 Office

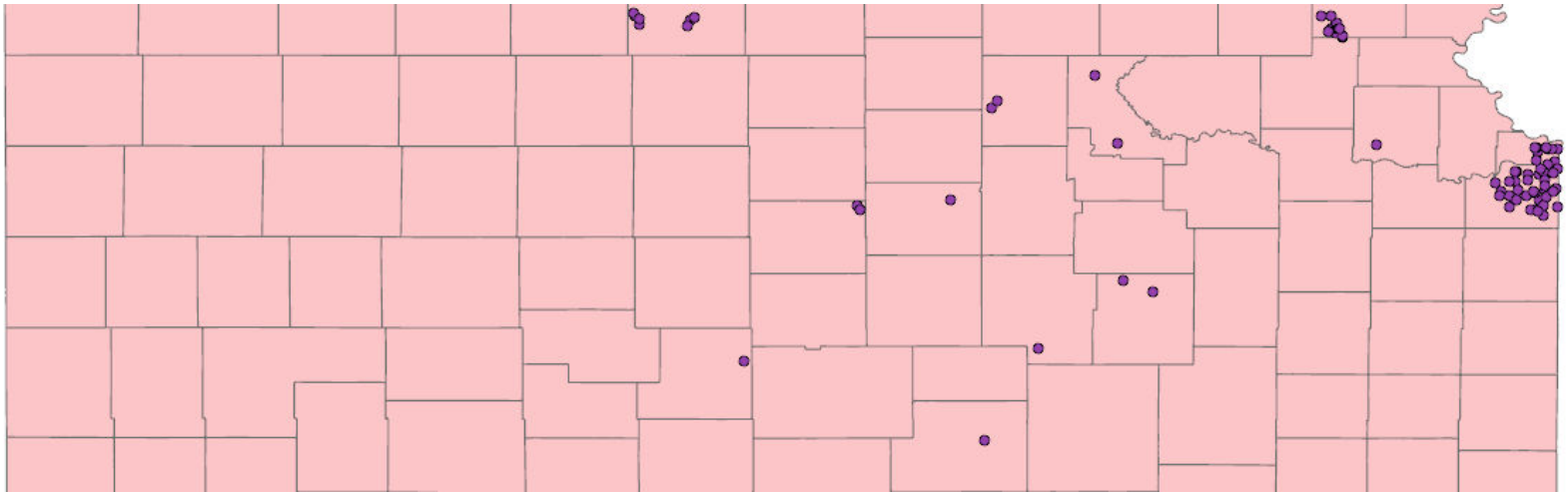
1. EPA's page for water quality standards

US Geological Survey

1. The USGS maintains a number of continuous water quality gauges in the state of Kansas.

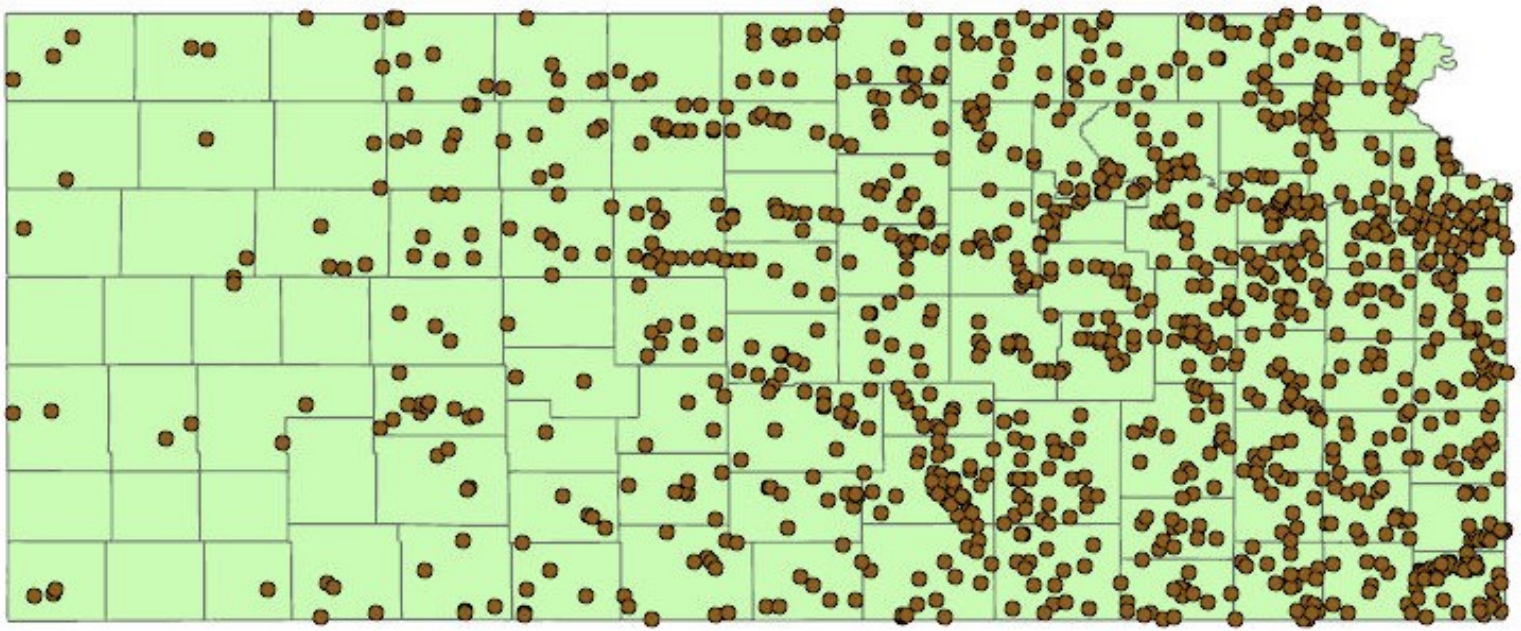
All of this data is aggregated together in the Water Quality Portal (Link)

EPA Region 7 Office Test Sites in Kansas



Dataset Used: EPA Region 7 Kansas locations

KDHE Test Sites in Kansas



Dataset Used: KDHE locations

Information in the Water Quality Portal

Table: A selection of characteristics for which test results are available in the Water Quality Portal

Characteristic Name	Freq.	Percent
Alkalinity	21,362	2.93
Barium	21,288	2.92
Calcium	21,336	2.93
Chloride	21,347	2.93
Escherichia coli	13,776	0.53
Fluoride	19,432	2.67
Hardness, Ca, Mg	21,327	2.93
Kjeldahl nitrogen	20,529	2.82
Magnesium	21,336	2.93
Nickel	20,136	2.76
Phosphorus	20,464	2.81
Potassium	21,337	2.93
Silica	21,336	2.93
Sodium	21,337	2.93
Specific conductance	21,364	2.93
Sulfate	21,349	2.93
Turbidity	21,209	2.91
pH	21,800	2.99
Total	728,487	

Data Structure

Water Quality Portal Data Structure

Data is structured at the characteristic - location - institution level.

Data Wrangling: Part 1

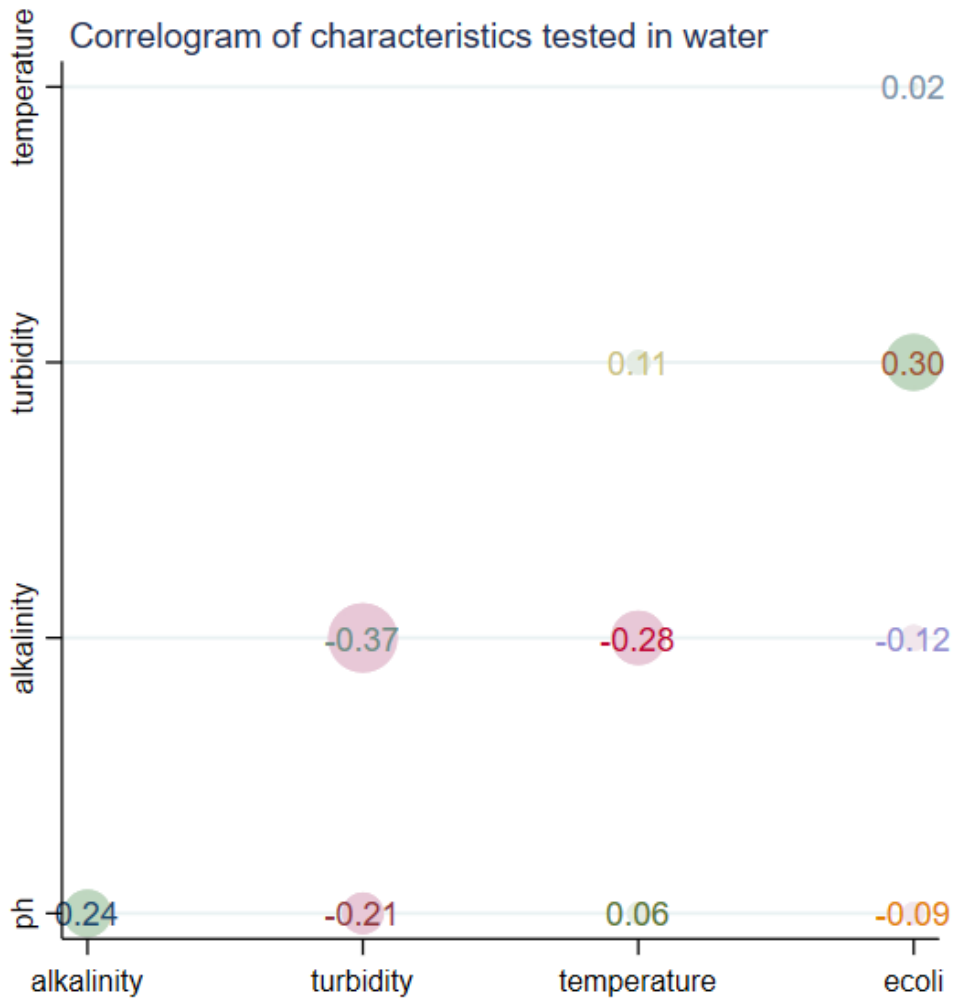
Separate out EPA Region 7 data, KDHE data, and USGS data. Construct a panel over time by location-year for each of those subsets.

Data Wrangling: Part 2

Use ArcGIS spatial joins to add various geographical boundaries on the lat-lon specific locations in the Water Quality Portal.

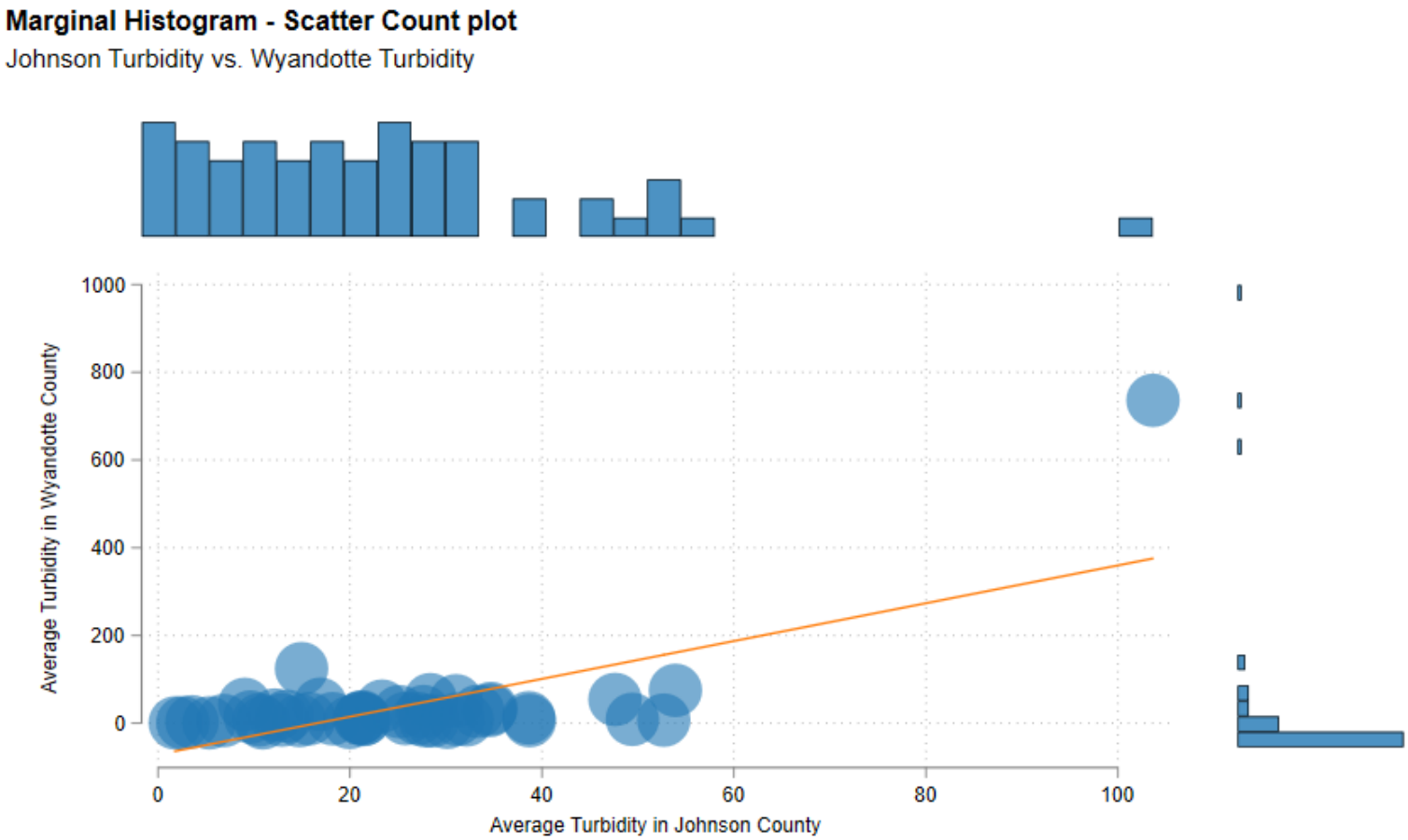
Descriptive Analysis

Are water characteristics associated with each other?



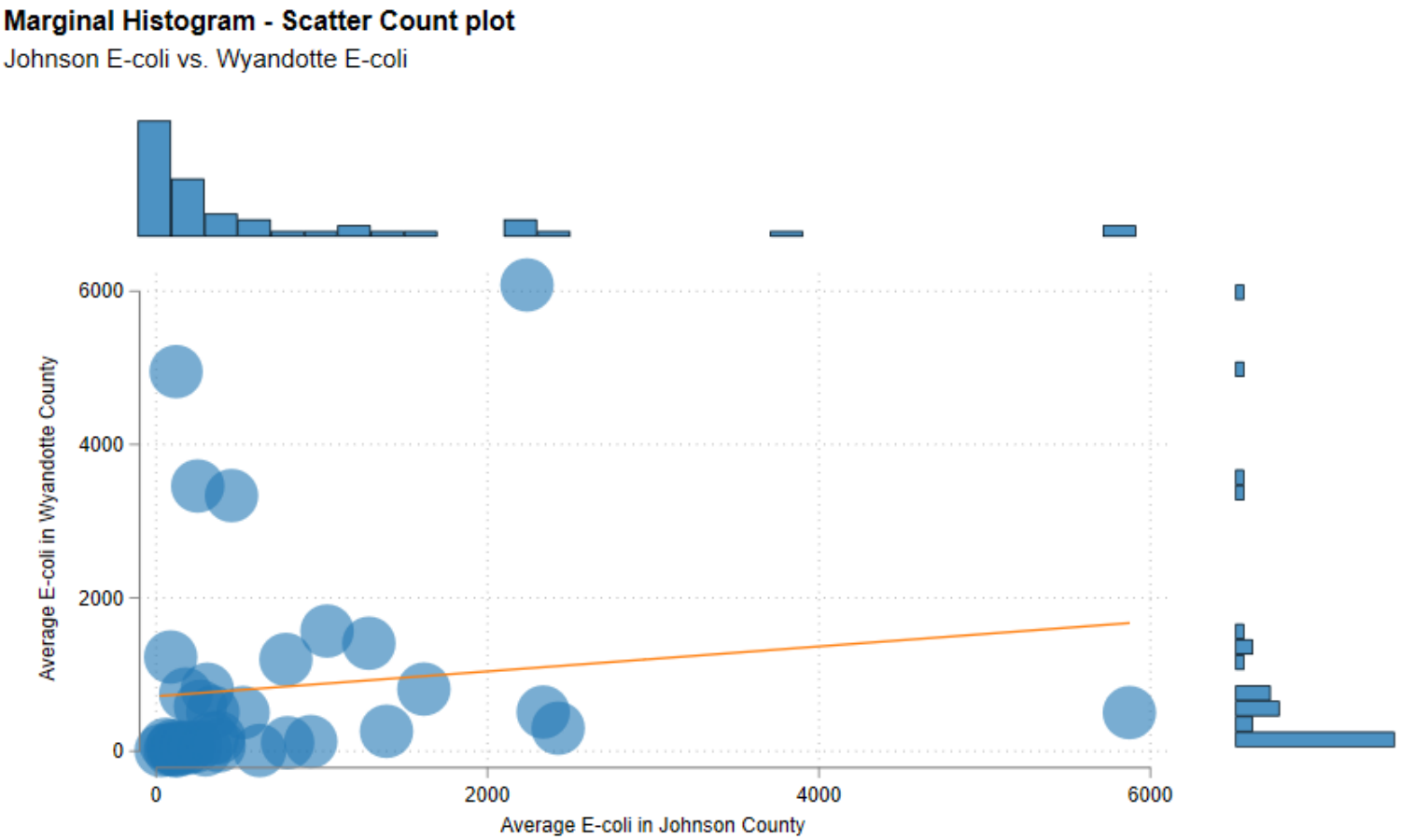
Dataset Used: KSDE Water Quality Portal Data

How do characteristics compare across space within Urban Streams Data? (Turbidity)



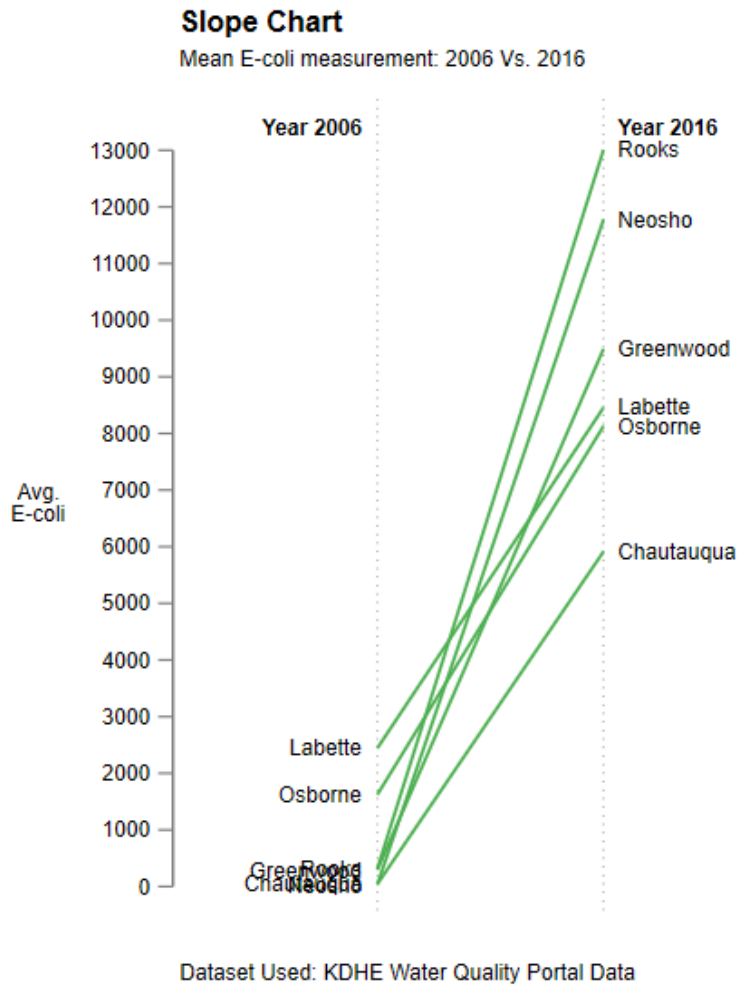
Dataset Used: EPA Region 7 Water Quality Portal Data

How do characteristics compare across space within Urban Streams Data? (E-coli)

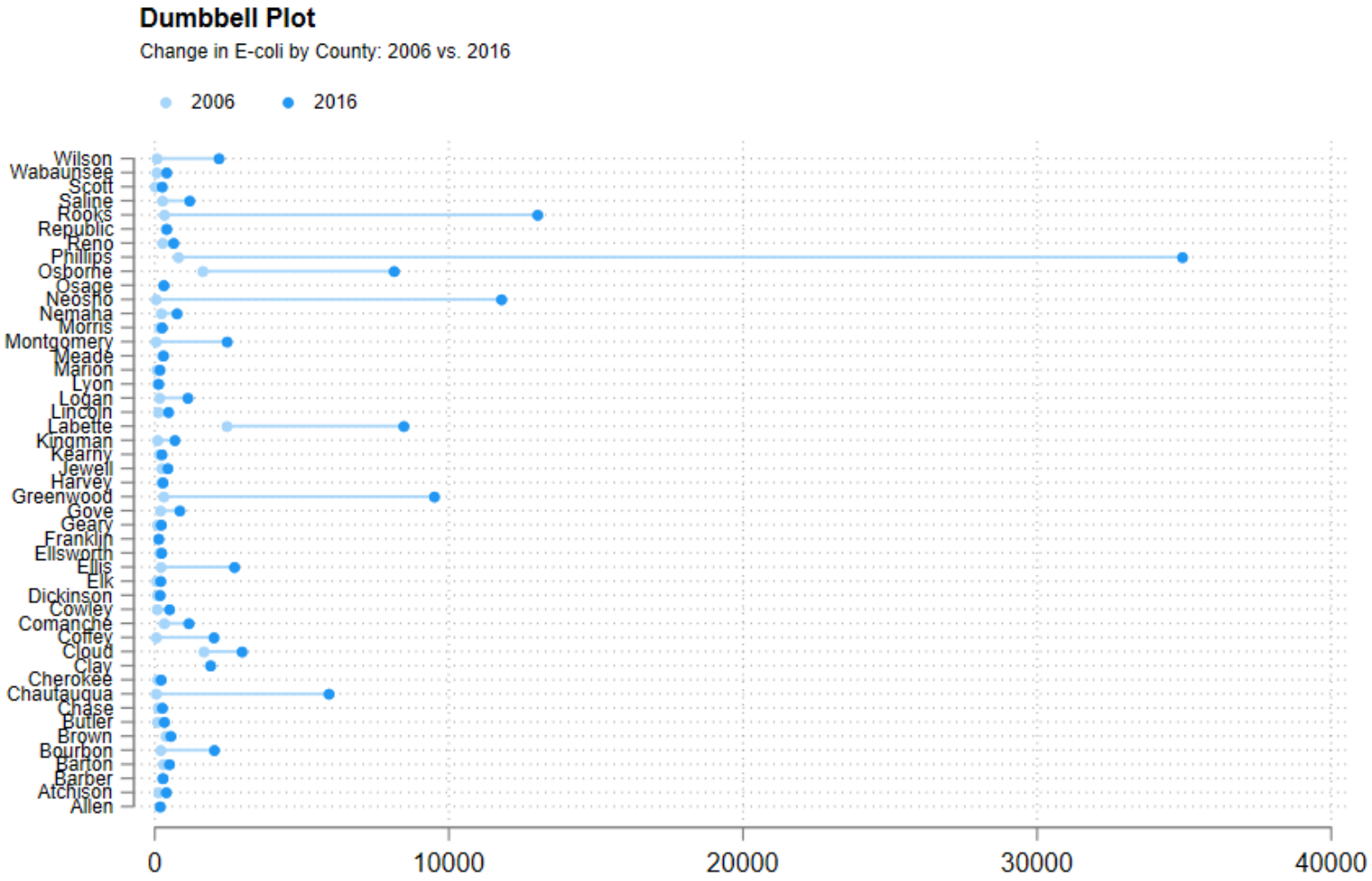


Dataset Used: EPA Region 7 Water Quality Portal Data

Expanding to all of Kansas: counties where E-coli measurements have significantly increased

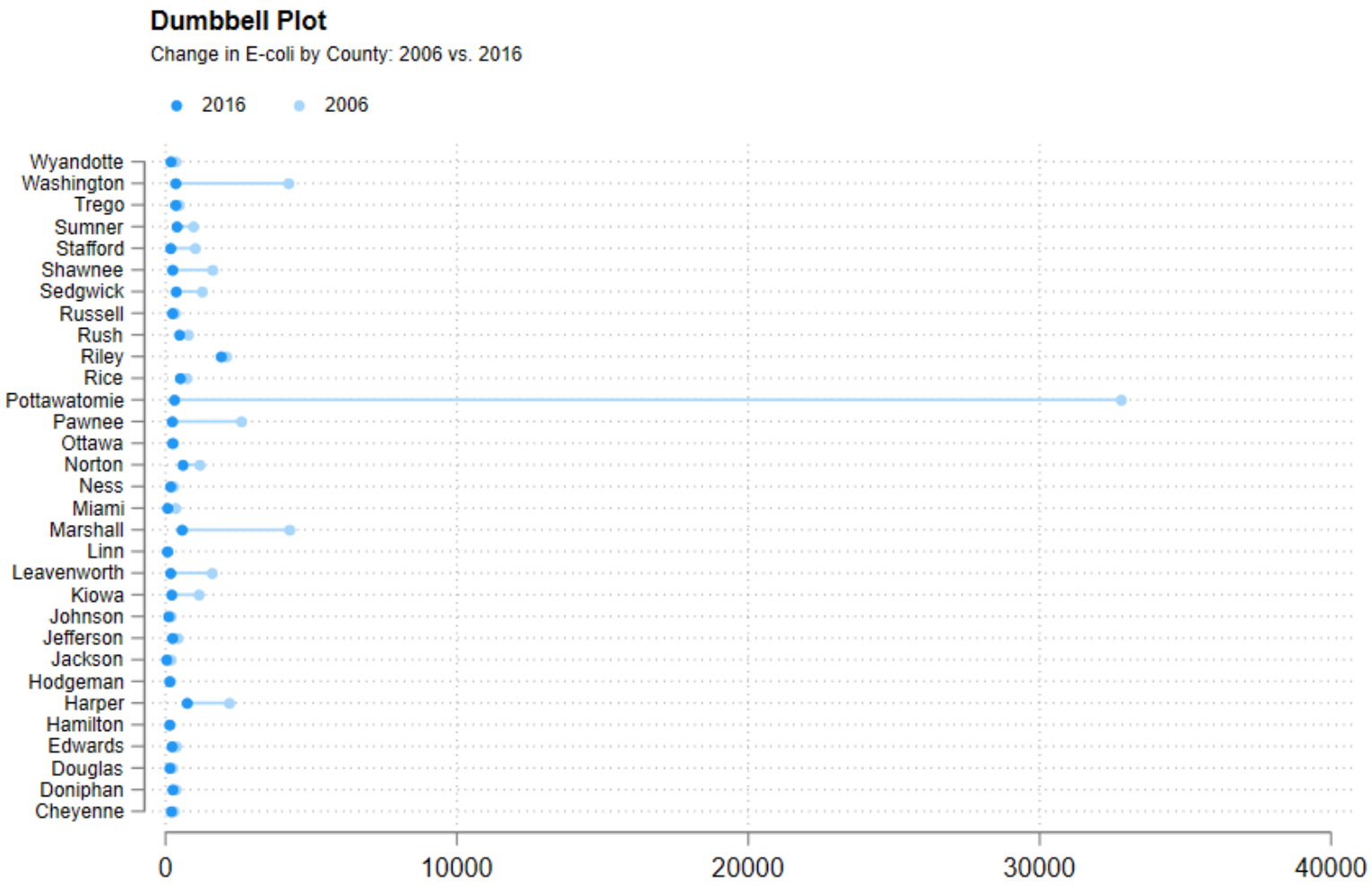


All counties which saw an E-coli increase between 2006 and 2016



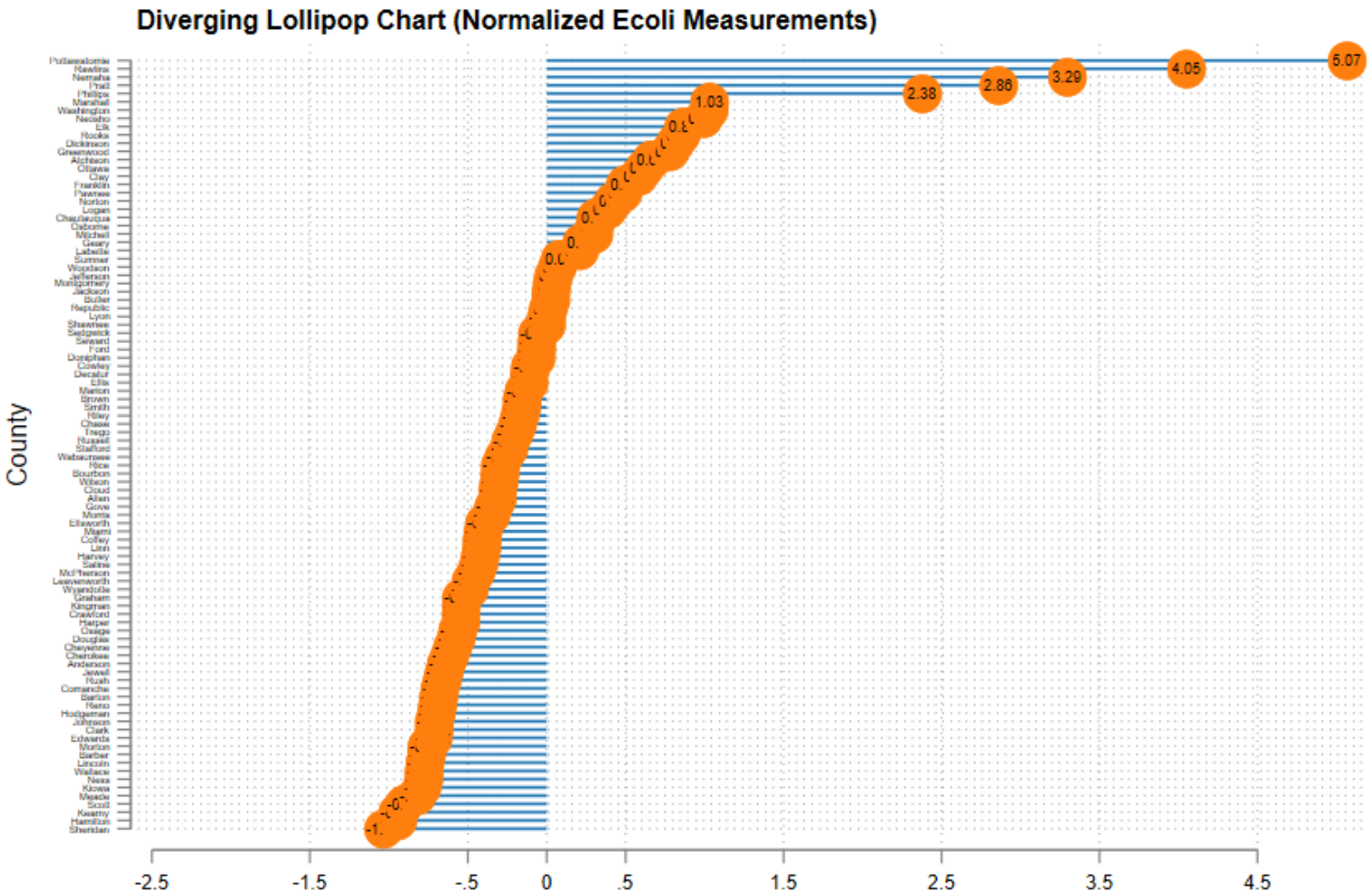
Data Used: KDHE Water Quality Portal Data

All counties which saw an E-coli decrease between 2006 and 2016



Data Used: KDHE Water Quality Portal Data

Average E-coli measurements across full sample time period by county



Data Used: KDHE Water Quality Portal Data

Demographics in Kansas at the County Level

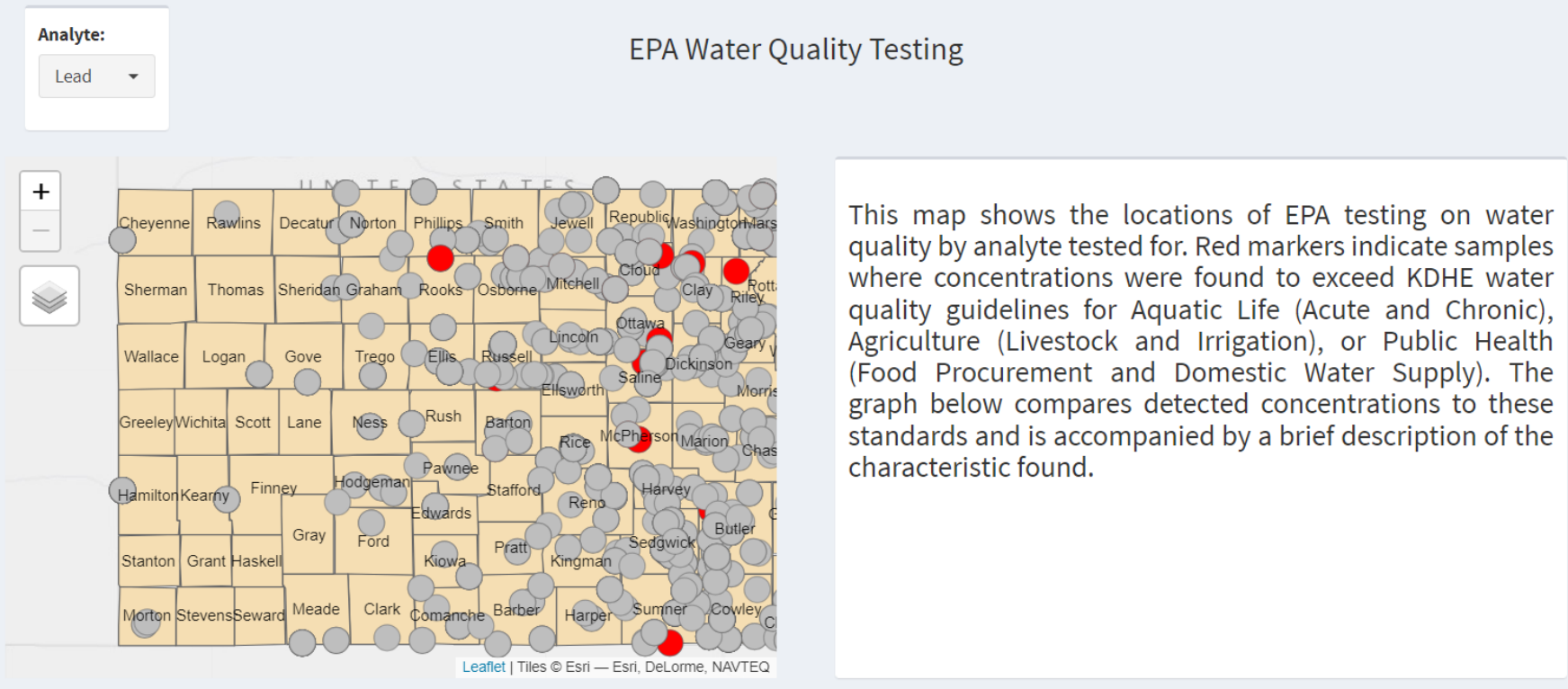
Table: County population and demographics range significantly across the 105 counties in Kansas

Variable	N	Mean	Std. Dev.	Min	Max
Population	105	27,973	81,714.79	1,223	619,195
Male	105	14,052	40,581.75	615	306,748
Female	105	13,921	41,138.33	608	312447
White	105	24,016	68,073.54	1,181	532,871
Black	105	1,740	6,828.96	8	48,711
Native American	105	42.34	111.00	0	753
Asian	105	901	4,137.60	3	33,788
Hispanic	105	3,648	11,276	73	84,538

Population impacted by changes in E-coli levels between 2006 and 2016

Variable	Untested Counties	Increased Counties	Decreased Counties
Counties	27	47	31
Population	249,448	714,958	1,972,744
Male	126,826	361,120	987,509
Female	122,622	353,838	985,235
White	229,684	649,011	164,2963
Black	6,108	22,519	154,029
Native American	589	1,356	2,501
Asian	4226	8,620	81,770
Hispanic	71,843	64,173	247,019

Sneak peak of the dashboard



Water quality interactive visualizations

Future work to complete dashboard

Include USGS water quality data

While we have worked to process the water quality tests conducted by KDHE and the EPA Region 7 Office, more work needs to be done to process the USGS water quality data.

Obtain updated water quality tests

Work with KDHE to obtain updated information about water quality tests post-2016.

Work to include the PWS water quality testing

Initial work has been done to scrape and process the CCRs for 2024. We need to work to obtain more historical information and to make the 2024 data useful for analysis.

Future research work on the economics of water quality in Kansas

1. Water Quality Portal tests surface-level water.
2. Consumer Confidence Reports measure contaminants in municipal water.

What could happen if we combined this data?

1. A wealth of information is sitting in these consumer confidence reports that is unstructured.
2. If we are able to connect surface water quality tests with Consumer Confidence Report water quality tests, it is possible to model the burden public water systems face to clean their water - and this would produce a cost estimate.

Developing work with public water systems

Collect data from Consumer Confidence Reports

1. The CCR Rule requires each Public Water System to provide an annual report on the quality of their water.
2. The CCR includes a variety of important information about a PWS, including the drinking water source, and monitored contaminants found in drinking water, and whether a PWS meets state and federal drinking water standards.

To date, we have scraped the CCR information for the public water system reports posted for 2024. Looking for more historical information as well.

Example CCR (KDHE CCR Page Link)

Testing Results for: CITY OF ABBYVILLE

Microbiological	Result	MCL	MCLG	Typical Source
COLIFORM (TCR)	In the month of October, 1 sample(s) returned as positive	Treatment Technique Trigger	0	Naturally present in the environment

Regulated Contaminants	Collection Date	Highest Value	Range (low/high)	Unit	MCL	MCLG	Typical Source
BARIUM	1/12/2021	0.14	0.14	ppm	2	2	Discharge from metal refineries
CHROMIUM	1/12/2021	1.4	1.4	ppb	100	100	Discharge from steel and pulp mills
FLUORIDE	1/12/2021	0.57	0.57	ppm	4	4	Natural deposits; Water additive which promotes strong teeth.
NITRATE	1/18/2022	7.6	7.6	ppm	10	10	Runoff from fertilizer use
SELENIUM	1/12/2021	2.2	2.2	ppb	50	50	Erosion of natural deposits

Lead and Copper	Monitoring Period	90th Percentile	Range (low/high)	Unit	AL	Sites Over AL	Typical Source
COPPER, FREE	2019 - 2021	0.185	0.046 - 0.23	ppm	1.3	0	Corrosion of household plumbing
LEAD	2019 - 2021	0.5	0 - 30	ppb	15	0	Corrosion of household plumbing

If present, elevated levels of lead can cause serious health problems, especially for pregnant women and young children. Lead in drinking water is primarily from materials and components associated with service lines and home plumbing. Your water system is responsible for providing high quality drinking water but cannot control the variety of materials used in plumbing components. When your water has been sitting for several hours, you can minimize the potential for lead exposure by flushing your tap for 30 seconds to 2 minutes before using water for drinking or cooking. If you are concerned about lead in your water, you may wish to have your water tested. Information on lead in drinking water, testing methods, and steps you can take to minimize exposure is available from the Safe Drinking Water Hotline or at http://www.epa.gov/safewater/lead.

Chlorine/Chloramines Maximum Disinfection Level	MPA	MPA Units	RAA	RAA Units
2022 - 2022	1.3700	MG/L	1.1	MG/L

Secondary Contaminants – Non-Health Based Contaminants - No Federal Maximum Contaminant Level (MCL) Established.	Collection Date	Highest Value	Range (low/high)	Unit	SMCL
ALKALINITY, TOTAL	1/12/2021	290	290	MG/L	300
CALCIUM	1/12/2021	70	70	MG/L	200
CHLORIDE	1/12/2021	77	77	MG/L	250
CONDUCTIVITY @ 25 C UMHOS/CM	1/12/2021	910	910	UMHO/CM	1500
CORROSIVITY	1/12/2021	0.25	0.25	LANG	0
HARDNESS, TOTAL (AS CACO3)	1/12/2021	200	200	MG/L	400
MAGNESIUM	1/12/2021	7.1	7.1	MG/L	150
NICKEL	1/12/2021	0.0059	0.0059	MG/L	0.1
PH	1/12/2021	7.6	7.6	PH	8.5
PHOSPHORUS, TOTAL	1/12/2021	0.041	0.041	MG/L	5
POTASSIUM	1/12/2021	2.2	2.2	MG/L	100
SILICA	1/12/2021	27	27	MG/L	50
SODIUM	1/12/2021	130	130	MG/L	100
SULFATE	1/12/2021	25	25	MG/L	250
TDS	1/10/2018	520	520	MG/L	500

Please Note: Because of sampling schedules, results may be older than 1 year.

During the 2022 calendar year, we had the below noted violation(s) of drinking water regulations.

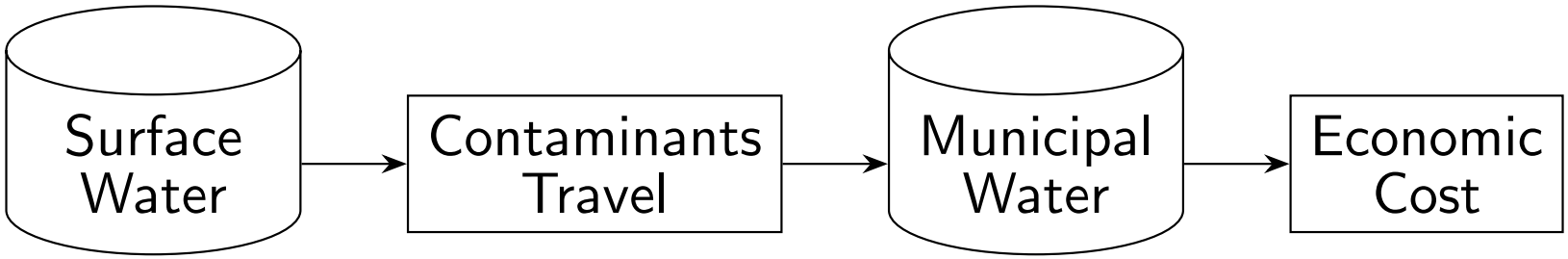
Compliance Period	Analyte	Comments
12/30/2021 - 5/9/2022	LEAD & COPPER RULE	LEAD CONSUMER NOTICE (LCR)

Future research work on the economics of water quality in Kansas

1. Water Quality Portal tests surface-level water.
2. Consumer Confidence Reports measure contaminants in municipal water.

Economic Calculation

Several models exist for water treatment cost calculations. We propose to use the model from the EPA: LINK



(1) Model this relationship (2) Calculate

Questions and Feedback

Thank you for your survey responses